REMARKS

Claims 1, 2, 12, 17, 23, and 26-28 have been amended. Claims 1-30 are pending in the application. Applicants reserve the right to pursue the original claims and other claims in this and other applications.

Claims 1-10, 12, 17, 23, and 26-29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over review of Chu, et al. ("Chu") in view of JP 2001 212253 ("Yasushi"). This rejection is respectfully traversed.

The Office Action fails to establish a prima facie case of obviousness at least because Chu in view of Yasushi, even if properly combinable, do not teach or suggest every element of independent claims 1, 12, 17, 23, and 26-28. To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

Claim 1 recites, *inter alia*, "said plurality of second scatterers of the second scatterer device each being configured to have higher scatter strength in the central side than in the radially outer peripheral side to provide a beam irradiation of a double scattering method in combination with said first scatterer of the first scatterer device." Chu and Yasushi, alone or in combination, do not teach or suggest this limitation.

In the present invention, the plural second scatterers of the second scatterer device are each configured to have higher scatter strength in the central side than in the radially outer peripheral side so that the second scatterer modulates the ion beam, which has been spread out into a Gaussian distribution by the first scatterer, to produce a uniform dose distribution, thereby providing a beam irradiation of a double scattering method in combination with said first scatterer of the first scatterer device.

In Chu, the second scatterer is not configured as recited in claim 1, and thus the second scatterer is not one to provide a beam irradiation of a double scattering method in combination with the first scatterer. More specifically, Chu discloses a beam delivery system

of a double scattering method comprising a first scatterer and a second scatterer, but in the delivery system, an occluding post (Figure 35) or occluding post and ring (Figure 36) is disposed between the first and second scatterer. (Chu, pg. 2081, Figures 35 and 36). Further, Chu describes the "double-scattering beam delivery method" as "us[ing] an occluding post of sufficient thickness to stop the beam particles which is placed in such a way that it blocks the central portion of the Gaussian distributions. Past the occluder, ... The second scatterer, <u>of an appropriate thickness</u> and placed strategically, diffuses the particles in these two peaks filling the dose void in the middle, and produces at the isocenter a larger flat-does area. ..." (Chu, pg. 2080, emphasis added). Thus, the beam delivery method shown in Chu Figures 35 and 36 is of the double-scattering method using the occluding post (Figure 35) or occluding post and ring (Figure 36), but not one using the second scatterer configured to have higher scatter strength in the central side than in the radially outer peripheral side.

The present invention contemplates solving the problem of a case in which the beam is delivered by the double scattering method using the second scatterer configured to have higher scatter strength in the central side than in the radially outer peripheral side. As discussed in the specification, the prior art is lacking in several respects:

(1) In the double scattering method, arranging the scatterers at positions as near as possible to the most upstream side is effective in decreasing the thickness of each of the first and second scatterers to reduce the range loss, and in extending the range to increase the penetration depth in the patient body. While the first scatterer is usually arranged near the most upstream side in the irradiation field producing equipment, the second scatterer is also preferably arranged, from the standpoint of increasing the range length, at a position as near as possible to the most upstream side so that the distance between the first and second scatterers is minimized.

(2) Alternately, in the double scattering method, if a deviation occurs between an axis along which the ion beam travels and the center position of the second scatterer, dose uniformity deteriorates depending on the deviation to a larger extent as the distance between the first and second scatterers decreases. From the standpoint of improving dose uniformity,

therefore, the second scatterer is preferably arranged at a position as near as possible to the most downstream side so that the distance between the first and second scatterers is maximized.

(3) As a result, in design of the known irradiation field producing equipment, an optimum mount position of the second scatterer is decided in consideration of balance between a longer range and higher dose uniformity. However, when an available maximum field size is increased in the equipment responsive to the need for a larger size of the irradiation field as mentioned above, a proper mount position of the second scatterer in the case of producing a comparatively large field size greatly differs from the proper mount position thereof in the case of producing a comparatively small field size. Accordingly, it has been difficult to always realize irradiation with a long range and high dose uniformity regardless of the field size.

The double scattering method above in respects (1) and (2) means that the double scattering method using the second scatterer is configured to have higher scatter strength in the central side than in the radially outer peripheral side, and the problem of "if a deviation occurs between an axis along which the ion beam travels and the center position of the second scatterer, dose uniformity deteriorates depending on the deviation to a larger extent as the distance between the first and second scatterers decreases" occurs because the second scatterer has higher scatter strength in the central side than in the radially outer peripheral side. Because Chu does not use such a second scatterer, Chu's beam delivery system does not have such a problem. Thus, Chu does not disclose, teach, or suggest a means for solving such a problem.

The present invention (i.e., the subject matter recited in claim 1), however, is directed to the beam irradiation of the double scattering method using the second scatterer configured to have higher scatter strength in the central side than in the radially outer peripheral side. Specifically, the present invention comprises the following features that address the above-described problem:

(a) Two scatterer devices of a first scatterer device and a second scatterer device are arranged;

(b) The second scatterer device includes a plurality of second scatterers through which the charged particle beam passes after having passed the first scatterer, the second scatterer device causing one of the second scatterers to position in a passage region of the charged particle beam at one of the plural different positions in the direction of travel of the charged particle beam;

(c) The second scatterers include a second scatterer for smaller irradiation field size caused to position in the passage region at a first position in the direction of travel of the charged particle beam and used when the collimator is adapted for a relatively small first irradiation field and another second scatterer for larger irradiation field size cause to position in the passage region at a second position upstream of the first position in the direction of travel of the charged particle beam and used when the collimator is adapted for a larger second irradiation field than the first irradiation field; and

(d) The second scatterer for smaller irradiation field size caused to position in the passage region at the first position has a thickness different from that of said another second scatterer for larger irradiation field caused to position in the passage region at the second position so as to provide smaller scattering strength of the charged particle beam in a direction perpendicular to that direction of travel of the charged particle beam than said another second scatterer for the larger irradiation field size.

Chu discloses that "[w]hen the energy of the beam is modulated by an absorber and consequently the values of the beam widths are made larger, the occluder assembly may be moved upstream nearer to the first scatterer so that the projected radii at the isocenter are proportionally increased. This process compensates the parameters in such a way that the resulting does distribution again exhibits an acceptable deviation from the average." (Chu, page 2082).

However, Chu's "absorber" is a kind of scatterer and therefore if the "absorber" is arranged, the beam width is increased correspondingly (the scattering strength of a beam in the direction perpendicular to the direction of the beam traveling is increased correspondingly), in order to maintain the uniformity of dose distribution at the isocenter, it is required to move the occluder assembly upstream nearer to the first scatterer. In Chu, however, no reference is made as to movement of the second scatterer located downward of the occluder assembly as a separate member or how to move the second scatterer.

In the present invention, not only the second scatterer is changed in position, but also the thickness of the second scatterer is changed. Chu, however, does not teach changing the thickness of the second scatterer in combination with the changing the position of the second scatterer. Furthermore, since Chu does not address the problem of when "a deviation occurs between an axis along which the ion beam travels and the center position of the second scatterer, dose uniformity deteriorates depending on the deviation to a larger extent as the distance between the first and second scatterers decreases." In Chu's double-scattering method using the occluder assembly, it is not necessary to change the thickness of the second scatterer.

Thus, Chu neither discloses the basic concept of the present invention performing beam irradiation of the double scattering method using the second scatterer configured to have higher scatter strength in the central side than in the radially outer peripheral side, nor suggests the above-detailed features of the present invention that solve the problem described in detail above. Yasushi only discloses the concept of changing the position of a scatterer by selectively using the scatterers arranged in different positions, and, like Chu, it neither discloses the basic concept of the present invention nor suggests the above-detailed features of the present invention which solve the problem described in detail above. Further, Yasushi is not directed to double scattering method irradiation systems, therefore the role of any scatterers disclosed by Yasushi fundamentally differ from those of the present invention.

Since Chu and Yasushi, separately or in combination, do not teach or suggest all of the limitations of claim 1, claim 1 is not obvious over the cited references. Independent

claims 2, 12, 17, 23, 26, 27 and 28 contain limitations similar to those contained in claim 1 and are allowable for the same reasons. Claims 3-6 depend from claim 2 and are patentable at least for the reasons mentioned above. Claims 7-10 depend from claim 26 and are patentable at least for the reasons mentioned above. Claim 29 depends from claim 28 and is patentable at least for the reasons mentioned above. Applicants respectfully request that the rejection be withdrawn and the claims allowed.

Claims 11, 15, 16, 21, and 22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chu in view of Yasushi and either Moyers or Hernandez. This rejection is respectfully traversed. Claim 11 depends from claim 26, claims 15 and 16 depend from claim 12, and claims 21 and 22 depend from claim 17 and are patentable over Chu and Yasushi for at least the reasons mentioned above. Moyers and Hernandez do not cure the deficiencies of Chu and Yasushi discussed above. Accordingly, Applicants respectfully request that the rejection be withdrawn and the claims allowed.

Claims 13, 14, 18-20, 24, 25, and 30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chu in view of Yasushi and Huntziger. This rejection is respectfully traversed. Claims 13 and 14 depend from claim 12, claims 18-20 depend from claim 17, claims 24 and 25 depend from claim 23, and claim 30 depends from claim 28 and are patentable over Chu and Yasushi for at least the reasons mentioned above. Huntziger does not cure the deficiencies of Chu and Yasushi discussed above. Accordingly, Applicants respectfully request that the rejection be withdrawn and the claims allowed.

In view of the above, Applicants believes the pending application is in condition for allowance.

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Respectfully submitted,

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